Every new mountain observatory is a new field of aerial exploration greatly needed and most welcome to the true meteorologist.—*C. A.*

The interest in the frost studies has been heightened by a second observation like the one already mentioned, i. e., that low temperatures on Mount Rose seem to precede those below at Reno and in the northern section of Nevada by from twenty-four to thirty-six hours. Thus on the morning of June 6 (2 to 5 a. m.) the thermograph on the summit registered 11° F. The temperature during the day registered from 23° to 20° F., rising from 10 p. m. until about 6 a. m. of the 7th, when it registered 37° F. On the morning of the 7th, at Reno, however, a killing frost was reported, twenty-four hours after the corresponding condition on Mount Rose had occurred and at the same time as the rise of temperature from 20° to 37° F. was taking place on that peak. If there had been a simultaneous correspondence on Mount Rose and at Reno, the frost at Reno should have occurred on the morning of the 6th and a temperature of approximately 57° F. should have been recorded at that place on the morning of the 7th.

The Nevada Agricultural Experiment Station has now, with the consent of the Division of Experiment Stations, made an appropriation for the purpose of continuing these frost studies and investigations in precipitation and evaporation at high altitudes. This will enable us to obtain an anemometer, a barograph, and a thermograph capable of making a month's continuous record, and a small observatory ten feet square for housing instruments and sheltering observers. A large precipitation tank and small evaporation tubs will be installed. The standard thermograph and barograph now in use may be placed elsewhere, either on Mount Rose or on a neighboring peak, to continue the study of barometric and thermometric peculiarities mentioned in my article; they may also be used in the further study of plant environment on Mount Rose.

It is interesting to note that the mean daily range of temperature on Mount Rose has not increased to a remarkable degree, the extremes during June being 5° and 23°, and that the approximate difference in temperature of 20° between Reno and Mount Rose has been increased often to 30° or more.[9] A more careful comparison of both winter and summer readings at the two stations will be made as opportunity is afforded.—*J. E. C., jr., July 26, 1906.*

## USE OF THE LANTERN IN TEACHING METEOROLOGY.

By J. PAUL GOODE, Assistant Professor of Geography, University of Chicago. Dated Chicago, Ill., July 1, 1906.

With many well meaning people the magic lantern is in something of disrepute. One says, "When I see a lecturer beginning to set up his screen and lantern, I know that now there is to be put on exhibition a plentiful lack of wit". And another says,[1] "The instruction in meteorology * * * needs to be of a fundamental, solid character, and not of the popular, superficial character appropriate to lectures that are illustrated by lantern slides"; and again, "A lecture with stereopticon illustrations should come in only as a sort of luxury once or twice during the course".

This attitude of antipathy is catching, like measles, and in many places settles the question of the use of the lantern without argument or evidence, adversely to the judgment and interests of the growing scientific teacher. Of course we all know the brainless person, who calls for "the next slide"; and announces the very obvious fact: "This is the picture of a house"—going through with a so-called "lecture" by talking about a collection of slides. Such performances may be entertaining, but they are often neither scientific nor literary, and may have little or no power of instruction. But to pass judgment on the use of the lantern upon such a basis of evidence is on a par with the action of the good people who condemn all novels because there are, forsooth, dime novels. We can all understand this impatience with the merely entertaining use of the lantern, but that is only one side of the shield. Let us look at the other side.

We will all agree that, from any point of view, the most fundamental element of geography is the matter of space relation. In its ultimate phase, geography is the science of the "where", and the written language of the "where" is the map and diagram. Now we can not *talk* a map. We see a map, and we think it in terms of space relation, in terms of form and place, but we can only talk *about* these things. The sight language is many times more rapid and efficient than the verbal description of the visible forms. It is a sort of *shorthand* of form and space relation. Think of how long a chapter it would make to describe a map of the North American Continent, in its three dimensions, with its mountain axes, and with its intricate detail of coast line and drainage. And yet this mass of detail is presented to the eye in an instant. One second of view brings to us a quantity of perceptions it would take many minutes to relate even in part. In short the sight language, compared with the word language, is as the flight of an eagle, compared with the painful passage of an ox team. Moreover, we can keep the map in mind easily, while the very number of things listed in words becomes difficult of retention in memory, and very hard to correlate. We all understand this. We want the map when we really want to know the lay of the land, and no amount of explanation will take its place. So we provide our libraries with atlases and our geographies with maps, and even the clerk of the rural school sees to it that the schoolroom is supplied with some kind of wall maps. Our best schools have more wall maps and better ones, yet scarcely one has so many or such good ones as could be most profitably used in class work by a live and well trained teacher.

But wall maps are expensive. They run from three or four dollars apiece to several times that price, and the mere cost of a large collection becomes burdensome to the best of schools. They are bulky, and their storage is a problem, and the larger the number the harder this problem. Then, too, they deteriorate rapidly, even under the best of use. All these handicaps are so effective that the result is a very small and inadequate collection of wall maps in the average class room.

But the teacher in geography and meteorology must use maps. And we who are teaching know too well the waste of time and attention, and the cancellation of good teaching, when we attempt to do the next thing, that is, to bring into the class the good map or intricate diagram which we may have found in the MONTHLY WEATHER REVIEW, and which shows exactly what we want to present. We put up the beautiful little drawing before the class and the two pupils in the front row, nearest the map, get a good view and can follow the discussion. Those a little farther away can see a little, but uncomfortably. If the class is of ordinary size the others can not see, and in so far can not attend the recitation; they do not know what is going on up in front, and disorder enters the room. In a well trained school they may look wise and make no disorder, but they are barred from participation in the recitation. But then, of course, the map can be passed around, yet this is only less bad than the other way. The discussion was for the benefit of the two who could see the map. The teacher has now passed on to another topic. The map comes to a pupil who may now see what he was hearing about some time before, but in seeing he must lose the recitation just now in progress. And the attention and concentration of the whole class for a good fraction of the recitation is sacrificed to the lack of proper equipment—the want of a map that all may see at once and at the time when the seeing should be done. And is it not a pity that this high tariff should be imposed upon teaching, when by the expenditure of fifty cents that map may

[9] The latest records have been added to Table 1, page 258.—ED.

[1] See Monthly Weather Review for January and October, 1905, Vol. XXXIII, pp. 15 and 444.

be converted into a slide, which in an instant is thrown on the screen, much larger and more legible than any wall map, visible to everyone in the largest class at one and the same time? The teacher may put his pointer upon the very spot he wants discussed and all the pupils may be solving the problem together with equal advantage. And then the next point comes up for discussion, with no abatement or diversion of interest or attention on the part of any one.

But the ready advice comes:[1] "Carefully drawn charts elucidate hurricanes", and, "It is especially important for the teacher himself to be so interested in his subject as to devise his own diagrams", and, "It is only after one has taught in his own original way for several years, that he begins to realize the power of his own ingenuity, and finds that he is doing better, with crude material, than many another man is doing with elaborate equipment." This is the encouragement a hard working and earnest teacher gets. He is doing so well with no advantages, it really is not worth while to give him any.

The writer of this paper can speak about this question from the point of view of that very teacher; for, after seventeen years' teaching in normal schools and universities, much of the time without equipment, having to devise the maps and graphs and make them too, or go without, for lack of mere time and strength, and much of the time nourished upon this appetizing sawdust of doing better work than some one else who has a good equipment, he is in a position to know the condition of the average teacher in this country. Be it known then that there are many teachers in our normal schools and high schools who are required to do from twenty-five to thirty hours of teaching per week, and with classes very often running to fifty or over. Now the man in the office thinks what a snap it is to be a teacher with only five hours of work a day; but this teacher, after his day's work, must prepare laboratory exercises and arrange the laboratory material and apparatus for the next day's work, must prepare the presentation of the subject matter of to-morrow's five recitations, and must look over and correct laboratory exercises of anywhere from fifty to two hundred and fifty pupils, and every month or so read the written examinations of as many more, which reading, if properly done, will demand every spare minute for a week or so. Then, after this fourteen or sixteen-hour day, he has an opportunity to try to read along the lines of his chosen field, so as to keep up with the progress of science and grow a little. Then, if there is any time left, he may devote it to social intercourse! Meteorology is only one of several sciences he must handle, any one of which is a field large enough for a strong man to spend his whole time in, if he is to do the work well.

The material to be charted in meteorology is so plentiful and so various that it is out of the question to think of entering it on the general wall maps for meteorological teaching, even if the teacher were competent to do it. Nor is it an easy solution to think of making the map entire. Not very many teachers have had the good fortune to be trained in mechanical drawing; and, if they are trained in drawing, the materials cost a deal of money and the drawing takes a deal of time, neither of which can be spared by the average teacher. It is a keen personal realization of all these conditions adverse to the teacher and his class and to the growth of the science of meteorology, and an equally keen appreciation of the superiority of graphic material in the form of lantern slides for class instruction, which led the writer to propose to the Geographic Society of Chicago, a worthy bit of missionary work—that of providing an adequate collection of the graphic material necessary for the study and teaching of the subject, and of publishing this material in the form of lantern slides, accompanying them with an explanatory bulletin.

The cost of a lantern slide equipment is only a small fraction of the cost of a wall chart equipment on any basis. For teaching purposes it is the most convenient and most economical equipment possible. The lantern slide is the cheapest effective method of duplication. It is effective in a very high degree, because a slide may instantly be thrown upon the screen as large as is necessary for easy reading by the whole room. It is more effective for a class of ten than is the ordinary wall chart, but is equally effective with an audience of 2000, if the occasion requires it. So it serves a vastly wider public than a wall map can. In the form of lantern slides a hundred maps can be carried in one hand and one map can be substituted for another upon the screen in a fraction of a second. Moreover the hundred maps may be used in this room one hour, and then in another room or building the next hour. The slides are very easily stored and cared for, taking up the minimum of space with the maximum of accessibility.

The graphic material collected by the Society's committee consists of maps and diagrams from everywhere, graphs, photographs, and other illustrations, a total of 270 subjects. The work of collecting the material and of writing and editing the explanatory bulletin has been a labor of love—voluntary and without compensation.

It is now possible, for the first time, for a school to be equipped, for a few dollars, with every map and diagram necessary for the teaching of meteorology. The teacher may now put before his whole class at once, the maps of Buchan from the reports of the *Challenger* expedition; maps of Supan, Woeikof, and other foreign material difficult of access and hitherto not available at all to teacher or school in most places. Rare photographs and graphs made purposely for this series are here published for the first time. The instruction may now be given from a map or graph which all may see at once with equal advantage, and the teacher may cover several times the ground, with the time at his disposal, that he can without the equipment. The recitation may be on temperature distribution; here are 26 maps and 13 graphs at his disposal, everyone of which may be recited from by anyone in the class while the rest pay attention. In atmospheric pressure and circulation he has available 9 maps, 11 graphs, and 4 pictures. In the study of cloud forms there are 21 illustrations to choose from, each one a fine photograph of an actual cloud. The subject of study may be cyclonic storms and storm movement; he has at his disposal 83 maps, especially prepared for illustrating the various types of storms both in America and Europe, often arranged four on one slide for convenience in instant comparison and contrast; in several cases one storm is charted in its progress for several days, one day's map occupying one slide, so the conditions are best presented for exercise in forecasting. This is the best series of storms available in twenty years' record of the United States Weather Bureau maps, and is the most complete set for study ever issued. Thunderstorms, tornadoes, and floods are generously illustrated in map, graph, and photograph. Two fine photographs of the funnel cloud of destructive tornadoes are here published for the first time.

For a special study of weather conditions at Chicago, bringing out in considerable detail the influence of Lake Michigan upon the weather, over 70 slides are available. This item, of course, is of greatest interest to teachers in the vicinity of Chicago, though the attempt has been made to give every illustration in this series a general interest as well.

The slides are of the highest quality known in the art. They are made by the thousands, so as to get the manufacturer's lowest rate, and they are offered for sale by the Society at cost, thus eliminating the middleman's profit. It is earnestly hoped by the committee that their efforts will be appreciated by the teachers of physiography and meteorology everywhere, from the seventh grade to the college. And we gladly welcome suggestions from any source as to improvements or valuable additions to the series.

[1] See Monthly Weather Review for January and October, 1905, Vol. XXXIII, pp. 15 and 444.